

WHAT IS CLAIMED IS:

- 1 1. A method for processing a film over a substrate in a process
2 chamber, the method comprising:
3 flowing a process gas suitable for processing the film over the substrate
4 into the process chamber in accordance with a predetermined algorithm specifying
5 process conditions;
6 monitoring a parameter during processing of the film over a thickness
7 greater than 3 μm ; and
8 changing the process conditions in accordance with a correlation among
9 a value of the parameter, an optical property of the film, and the process conditions.
- 1 2. The method recited in claim 1 further comprising forming a
2 plasma in the process chamber from the process gas.
- 1 3. The method recited in claim 1 wherein monitoring the parameter
2 comprises monitoring the parameter during processing of the film over a thickness
3 greater than 5 μm .
- 1 4. The method recited in claim 1 wherein the predetermined
2 algorithm is optimized to control a vertical profile of the film.
- 1 5. The method recited in claim 1 wherein the predetermined
2 algorithm is optimized to control a horizontal profile of the film.
- 1 6. The method recited in claim 1 wherein changing the process
2 conditions is performed in response to a change in the parameter.
- 1 7. The method recited in claim 1 wherein the parameter comprises a
2 process parameter.
- 1 8. The method recited in claim 1 wherein the parameter comprises a
2 film-property parameter.
- 1 9. The method recited in claim 8 wherein the parameter comprises a
2 reflectometry measurement.

- 1 10. The method recited in claim 8 wherein the parameter comprises
2 an ellipsometry measurement.
- 1 11. The method recited in claim 1 wherein the parameter comprises a
2 stress uniformity of the film.
- 1 12. The method recited in claim 1 wherein changing the process
2 conditions is performed by a trained evaluation system.
- 1 13. The method recited in claim 12 wherein the trained evaluation
2 system comprises an expert system.
- 1 14. The method recited in claim 12 wherein the trained evaluation
2 system comprises a neural network.
- 1 15. The method recited in claim 1 wherein changing the process
2 conditions is performed to maintain a substantially constant value for the optical
3 property of the film throughout processing the film.
- 1 16. The method recited in claim 1 wherein changing the process
2 conditions is performed to deposit the film with a desired variation in the optical
3 property of the film throughout processing the film.
- 1 17. The method recited in claim 1 wherein the process gas comprises
2 a silicon-containing gas and an oxygen-containing gas.
- 1 18. The method recited in claim 1 wherein processing the film
2 comprises depositing the film.
- 1 19. The method recited in claim 1 wherein processing the film
2 comprises etching the film.
- 1 20. The method recited in claim 1 further comprising annealing the
2 film.
- 1 21. A method for forming an optical waveguide over a substrate in a
2 process chamber, the method comprising:
3 forming a plasma in the process chamber;

4 flowing a silicon-containing gas and an oxygen-containing gas into the
5 process chamber in accordance with a predetermined algorithm specifying process
6 conditions to deposit a film over the substrate;
7 monitoring a refractive-index value of the film during deposition of the
8 film over a thickness greater than 3 μm ; and
9 changing the process conditions in accordance with a correlation
10 between the refractive-index value and the process conditions.

1 22. The method recited in claim 21 wherein monitoring the
2 refractive-index value comprises monitoring the refractive-index value of the film
3 during deposition of the film over a thickness greater than 5 μm .

1 23. The method recited in claim 21 wherein the predetermined
2 algorithm is optimized to control a vertical profile of the film.

1 24. The method recited in claim 21 wherein the predetermined
2 algorithm is optimized to control a horizontal profile of the film.

1 25. The method recited in claim 21 wherein changing the process
2 conditions is performed by a trained evaluation system.

1 26. The method recited in claim 25 wherein the trained evaluation
2 system comprises an expert system.

1 27. The method recited in claim 25 wherein the trained evaluation
2 system comprises a neural network.

1 28. The method recited in claim 21 wherein changing the process
2 conditions is performed to maintain a substantially constant value for the refractive-
3 index value throughout the deposition.

1 29. The method recited in claim 21 wherein changing the process
2 conditions is performed to deposit the film with a desired variation in the refractive-
3 index value throughout the deposition.

1 30. The method recited in claim 21 wherein changing the process
2 conditions comprises increasing an RF source power for maintaining the plasma.

1 31. The method recited in claim 30 wherein the RF source power is
2 increased discretely.

1 32. The method recited in claim 30 wherein the RF source power is
2 increased continuously.

1 33. The method recited in claim 21 further comprising annealing the
2 film.

1 34. A thick-film processing system comprising:
2 a housing defining a process chamber;
3 a plasma-generating system operatively coupled to the process chamber;
4 a substrate holder configured to hold a substrate during substrate
5 processing;
6 a gas-delivery system configured to introduce gases into the process
7 chamber;
8 a pressure-control system for maintaining a selected pressure within the
9 process chamber;
10 a sensor disposed to monitor a parameter during processing within the
11 process chamber;
12 a controller for controlling the plasma-generating system, the gas-
13 delivery system, the sensor, and the pressure-control system; and
14 a memory coupled with the controller, the memory comprising a
15 computer-readable medium having a computer-readable program embodied therein for
16 directing operation of the thick-film processing system, the computer-readable program
17 including:
18 instructions to control the plasma-generating system to form a
19 plasma in the process chamber;
20 instructions to control the gas-delivery system to flow a process
21 gas suitable for depositing the film over the substrate in accordance with a
22 predetermined algorithm specifying process conditions;
23 instructions to control the sensor to monitor the parameter during
24 processing of the film over a thickness greater than 3 μm ; and

25 instructions to change the process conditions in accordance with
26 a correlation among a value of the parameter, an optical property of the film, and the
27 process conditions.

1 35. The thick-film processing system recited in claim 34 wherein the
2 instructions for monitoring the parameter comprise instructions for monitoring the
3 parameter over a thickness greater than 5 μm .

1 36. The thick-film processing system recited in claim 34 wherein the
2 predetermined algorithm is optimized to control a vertical profile of the film.

1 37. The thick-film processing system recited in claim 34 wherein the
2 predetermined algorithm is optimized to control a horizontal profile of the film.

1 38. The thick-film processing system recited in claim 34 wherein the
2 instructions to change the process conditions are executed in response to a change in
3 the parameter.

1 39. The thick-film processing system recited in claim 34 wherein the
2 sensor comprises a reflectometer.

1 40. The thick-film processing system recited in claim 34 wherein the
2 sensor comprises an ellipsometer.

1 41. The thick-film processing system recited in claim 34 wherein the
2 sensor is configured to measure a stress of the film.

1 42. The thick-film processing system recited in claim 34 wherein the
2 instructions for changing the process conditions are executed to maintain a substantially
3 constant value for the optical property of the film throughout depositing the film.

1 43. The thick-film processing system recited in claim 34 wherein the
2 instructions for changing the process conditions are executed to deposit the film with a
3 desired variation in the optical property of the film.